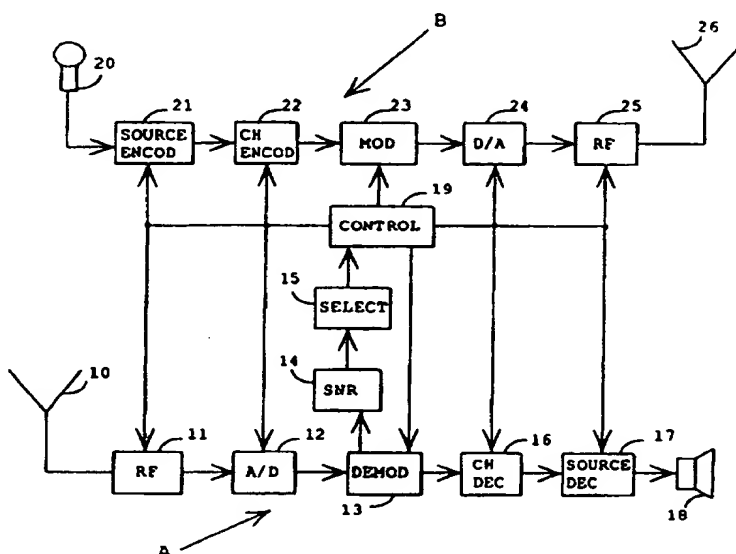




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : H04Q		A2	(11) International Publication Number: WO 97/29596
			(43) International Publication Date: 14 August 1997 (14.08.97)
(21) International Application Number: PCT/FI97/00064 (22) International Filing Date: 4 February 1997 (04.02.97) (30) Priority Data: 960541 6 February 1996 (06.02.96) FI (71) Applicant (for all designated States except US): NOKIA TELECOMMUNICATIONS OY [FI/FI]; Upseerinkatu 1, FIN-02600 Espoo (FI). (72) Inventors; and (75) Inventors/Applicants (for US only): HÄKKINEN, Hannu [FI/FI]; Vuokselantie 10 B, FIN-02140 Espoo (FI). GRANLUND, Seppo [FI/FI]; Meritullinkatu 9 B, FIN- 00170 Helsinki (FI). HÄMÄLÄINEN, Seppo [FI/FI]; Lintuvaarantie 21 A 5, FIN-02600 Espoo (FI). (74) Agent: TEKNOPOLOIS KOLSTER OY; c/o Kolster Oy AB, Iso Roobertinkatu 23, P.O. Box 148, FIN-00121 Helsinki (FI).			(81) Designated States: AU, BR, CA, CN, JP, KR, NO, NZ, PL, SG, US, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published <i>Without international search report and to be republished upon receipt of that report.</i>

(54) Title: A CONNECTION ESTABLISHMENT METHOD, A SUBSCRIBER TERMINAL UNIT AND A RADIO SYSTEM



(57) Abstract

The present invention relates to a method for establishing a random access type connection and a subscriber terminal equipment (37 to 38) and a radio system operating in accordance with the method. The subscriber terminal equipment (37 to 38) establishes a connection to several base stations (33 to 36) with the method of the invention. The base stations (33 to 36) are selected before establishing the connection by deducing the quality of the connection by means of pilot signals and both uplink and downlink interferences. The subscriber terminal equipment (37 to 38) has a connection to several base stations (33 to 36) already at the initial stage of the connection.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AM	Armenia	GB	United Kingdom	MW	Malawi
AT	Austria	GE	Georgia	MX	Mexico
AU	Australia	GN	Guinea	NE	Niger
BB	Barbados	GR	Greece	NL	Netherlands
BE	Belgium	HU	Hungary	NO	Norway
BF	Burkina Faso	IE	Ireland	NZ	New Zealand
BG	Bulgaria	IT	Italy	PL	Poland
BJ	Benin	JP	Japan	PT	Portugal
BR	Brazil	KE	Kenya	RO	Romania
BY	Belarus	KG	Kyrgyzstan	RU	Russian Federation
CA	Canada	KP	Democratic People's Republic of Korea	SD	Sudan
CF	Central African Republic	KR	Republic of Korea	SE	Sweden
CG	Congo	KZ	Kazakhstan	SG	Singapore
CH	Switzerland	LI	Liechtenstein	SI	Slovenia
CI	Côte d'Ivoire	LK	Sri Lanka	SK	Slovakia
CM	Cameroon	LR	Liberia	SN	Senegal
CN	China	LT	Lithuania	SZ	Swaziland
CS	Czechoslovakia	LU	Luxembourg	TD	Chad
CZ	Czech Republic	LV	Latvia	TG	Togo
DE	Germany	MC	Monaco	TJ	Tajikistan
DK	Denmark	MD	Republic of Moldova	TT	Trinidad and Tobago
EE	Estonia	MG	Madagascar	UA	Ukraine
ES	Spain	ML	Mali	UG	Uganda
FI	Finland	MN	Mongolia	US	United States of America
FR	France	MR	Mauritania	UZ	Uzbekistan
GA	Gabon			VN	Viet Nam

A CONNECTION ESTABLISHMENT METHOD, A SUBSCRIBER TERMINAL UNIT AND A RADIO SYSTEM

FIELD OF THE INVENTION

The invention relates to a connection establishment method
5 comprising a random access type connection establishment using a random
access channel, which is used in a radio system comprising several subscriber
terminal equipments and base stations where one or more transceiver units
operate, and in which system the connection establishment between the
subscriber terminal equipment and the base station is possible when the
10 subscriber terminal equipment is situated in the coverage area of one or more
transceiver units of the base station, in which area the subscriber terminal
equipment evaluates the quality of the connections to be established.

The invention further relates to a subscriber terminal equipment
which is arranged to establish a random access type connection by using a
15 random access channel in a radio system comprising several subscriber
terminal equipments and base stations which comprise one or more
transceiver units, and in which system the connection between the subscriber
terminal equipment and the base station is possible when the subscriber
terminal equipment is situated in the coverage area of one or more base
20 station transceiver units, where the subscriber terminal equipment comprises
an evaluation means for monitoring the quality of the connections to be
established.

The invention also relates to a radio system comprising several
subscriber terminal equipments and base stations which comprise one or more
25 transceiver units and where the subscriber terminal equipment is arranged to
send a random access type connection establishment request via a random
access channel and in which system the connection between the subscriber
terminal equipment and the base station is possible when the subscriber
terminal equipment is situated in the coverage area of one more transceiver
30 units of the base station, in which area the subscriber terminal equipment
comprises an evaluation means for monitoring the quality of the connections to
be established.

BACKGROUND OF THE INVENTION

A typical cellular radio system, such as the CDMA system (Code
35 Division Multiple Access), comprises a set of subscriber terminal equipments

and base stations. When a subscriber terminal equipment has no connection on a normal traffic channel, it monitors paging channels of the base station and when necessary, sends messages on an access channel to the base station. The paging channel and the access channel provide an organization
5 channel. When a connection is established in the cellular radio system between a subscriber terminal equipment and a base station, either the subscriber terminal equipment or the base station sends a connection establishment request on the organization channel. A specific Random Access Channel (RACH), which is a channel of a subscriber terminal equipment is
10 typically used as an access channel in the CDMA cellular radio system for establishing a connection from among all the possible access channels and from among the phases available for the phase of a pseudo-noise code. When a radio connection is to be established, the terminal equipments send a connection establishment message via an access channel to the base station
15 which forwards it to the system where traffic channel resources are allocated to the connection. When the base station requests a traffic channel connection, it sends via a paging channel a request to the subscriber terminal equipment which responds to the paging by requesting a traffic channel for its use via the access channel.

20 In the CDMA system, each base station sends continuously a pilot signal so that there is a specific pilot signal in different sectors or beams of the base station because each sector and beam has a specific base station transceiver unit. It is previously known to use a pilot signal for identifying a base station, a beam or sector of the base station. A pilot signal is a spread-
25 coded signal without data modulation which signal each base station sends continuously to its coverage area. The terminal equipment may identify the base station transceiver units by the pilot signal because the phases of the spreading codes in the pilot signal differ from one another. The subscriber terminal equipments continuously carry out measurements of pilot signals, and
30 subscriber terminal equipments establish an active group of the base station transceiver units providing the best connections, the base station transceiver units in the group being utilized when establishing new connections.

Each base station also sends on a sync channel. A signal of the sync channel may be demodulated and detected whenever the pilot signal can
35 be identified. Information is transmitted on the sync channel about the base

station, about the power and the phase of the pilot signal and about the size of uplink interferences.

In addition to a circuit-switched connection, the base station and the subscriber terminal equipment may communicate over a packet-mode
5 connection which is used in the PRMA system (Packet Reservation Multiple Access). In that case the channel needed for transmitting the signal is only reserved for the duration of the signal and it is released immediately when the signal is discontinuous or when it ends or has a break. If the signal is sent discontinuously, the channel has to reserved again after each break.

10 In prior art solutions, when a subscriber terminal is establishing a connection with a base station on the access channel, the connection is only to one base station, sector or beam of the base station. Access channel and paging channel connections are used especially when establishing a traffic channel connection, in which case when the connection establishment is
15 successful, the traffic channel will, at least at first, have a connection to only one base station, sector or beam of the base station. This raises a need to increase considerably the transmission power of the subscriber terminal equipment and/or the base station and carry out fast an updating of the active group, whereby interference level and the amount of signalling will increase.
20 Furthermore, during a packet-mode transmission it is difficult to carry out soft handover in the middle of the packet although the quality of the connection during the transmission would change to be favourable for handover.

A BRIEF DESCRIPTION OF THE INVENTION

The object of the present invention is to accomplish a solution
25 which will diminish interferences relating especially to the initial stage of the connection and enable the use of macrodiversity also for a packet-mode connection.

This is achieved with a method as shown in the preamble which is characterized in that the subscriber terminal equipment forms a random
30 access type connection to more than one base station transceiver unit included in one or more base stations.

The subscriber terminal equipment of the invention is characterized in that the subscriber terminal equipment comprises a control means for controlling a random access type connection establishment to more than one
35 base station transceiver included in one or more base stations.

The radio system of the invention is characterized in that the radio system comprises subscriber terminal equipment which is arranged to control a random access type connection establishment between the base station and the subscriber terminal equipment so that it is possible for the subscriber terminal equipment to establish a connection to more than one base station transceiver unit included in one or more base stations.

Considerable advantages are attained with the solution of the invention. By using the method of the invention, macrodiversity state will be assumed from the beginning of connection establishment. In that case the updating of the active group is required less and at the beginning of the connection, a lower transmission power can be used than in prior art solutions. In this way the need for signalling will be reduced and the capacity of the system will increase.

In a packet-mode data transmission, macrodiversity state will also be assumed directly, the state continuing for the duration of the whole packet in which case the quality of the provided connection will worsen less probably during the packet. The use of macrodiversity on a packet-mode connection is possible only by a method according to the invention because it is difficult to carry out soft handover during a packet.

In the SDMA technique (Space Division Multiple Access) the transmission and reception of the base station takes place in narrow beams, each of which has a specific base station transceiver unit. In that case the best connection is enabled with the method of the invention.

The preferred embodiments of the method of the invention will also appear from the appended dependent claims, the preferred embodiments of the subscriber terminal equipment of the invention will appear from the appended dependent claims relating to the subscriber terminal equipment and the preferred embodiments of the radio system of the invention will appear from the appended dependent claims relating to the radio system.

BRIEF DESCRIPTION OF THE FIGURES

In the following, the invention will be explained in more detail with reference to the examples of the accompanying drawings, where

Figure 1 illustrates the subscriber terminal equipment of the invention, and

Figure 2 illustrates the radio system of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the following, the invention will be explained in more detail by examining its operation in a CDMA cellular radio system without restricting it thereto. The invention is also suitable for use in a time division GSM (Global
5 System for Mobile communication) system and/or SDMA and PRMA systems.

Figure 1 illustrates the subscriber terminal equipment of the invention in its essential parts. The subscriber terminal equipment comprises a receiver part A and a transmitter part B. The receiver part A comprises an antenna 10, radio frequency parts 11, an A/D converter 12, a demodulator 13,
10 a signal quality evaluation means 14, selection means 15, a channel decoder 16, a source decoder 17 and a loud speaker 18. The transmitter part B comprises a microphone 20, a source encoder 21, a channel encoder 22, a modulator 23, a D/A converter 24, radio frequency parts 25 and an antenna 26.

15 The base station transceiver is in main parts similar to the subscriber terminal equipment without a loud speaker and a microphone. However, the base station transceiver generally comprises several reception antennas for space diversity reception. Because of this, the signals of different antennas are also combined by diversity combination means.

20 The reception part A operates in the following way. A radio frequency analogous signal received by the radio frequency parts 11 from the antenna 10 is transferred to an intermediate frequency and filtered. The signal filtered by the A/D converter 12 is converted into a digital signal. The demodulator 13 comprises an incoherent demodulator which restores a
25 broadband, spread-coded pseudo-noise signal to a narrowband data signal, and an orthogonal demodulator which determines the bits of the received data signal usually on the basis of correlation. Various diversity combinations are also carried out in the demodulator 13 if such diversity combinations are used in the receiver part A. An estimate, such as a signal noise estimate, is
30 provided by the signal quality evaluation means 14. The selection means 15 selects the base station transceiver unit candidates with the best connections for a future connection. The channel decoder 16 typically decodes a convolution-coded signal and its operation is based on a Viterbi algorithm, for example. Further, the channel decoder 16 generally comprises means for
35 decrypting and de-interleaving a pre-processed signal. The source decoder 17 generally decodes an RELP-coded signal (Residually Exited Linear Predictive

coder) received from the channel decoder 16, and D/A converts and at the end amplifies the signal into a form suitable for the loud speaker 18.

The transmitter part B operates in the following way. The microphone 20 receives an audio signal and sends an electronic response to the source decoder 21 which A/D-converts and RELP-codes it, for example. The digital signal from the source encoder 21 proceeds to the channel encoder 22 which typically convolution-codes the signal. Additionally, the channel encoder 22 typically encrypts the signal and interleaves the bits or bit groups of the signal. The convolution-coded narrowband signal is pseudo-noise encoded into a broadband spread spectrum signal in a modulator 23. After this, the spread spectrum signal is converted into an analogous signal by the D/A converter and the analogous signal is converted into a radio frequency signal in radio frequency parts 25 and sent via the antenna 26 in accordance with prior art.

A control means 19 controls the function of both the receiver part A and the transmitter part B. The means 13 to 17, 19 and 21 to 23 and the functions contained therein are implemented in prior art solutions by a signal handling processor and/or as an ASIC circuit. The antennas 10 and 26 are transmitter and receiver antennas of prior art radio systems. The microphone 20, the loud speaker 18, the radio frequency parts 11 and 24 and the A/D converter 12 and the D/A converter 24 are also prior art parts, used in prior art radio systems.

Figure 2 illustrates a schematic view of the radio system to be explained in the following on the basis of the CDMA technique without restricting the invention thereto. Two base station controllers 31 and 32 are connected to a mobile services switching centre 30 by digital transmission links, the base station controllers monitoring, for example, the number of the connections and deduce from that which of the connections proposed by a subscriber terminal equipment 37 are possible. Base stations 33 and 34, and correspondingly, base stations 35 and 36 are further connected to the base station controllers 31 and 32 by digital transmission links. Subscriber terminal equipments 37 and 38 have a connection to the base stations 33 to 36. Each base station controller and the base stations associated with it form a base station system. The coverage area of one base station typically forms one cell. Each of the base stations 33 to 36 has available a finite number of operating radio channels where pilot, sync, paging and traffic signals, for example, are

transmitted. Each base station 33 to 36 comprises one or more transceiver units 40 to 47. Their base station antennas may be antenna systems by means of which it is possible for different receiver units of the base station to link to different beams. Diversity antennas can also be used. In addition to the
5 transceiver units 40 to 47, the base stations 33 to 36 comprise peripheral equipments 50 comprising prior art means and power supplies associated with signal transmission, for example.

The method of the invention is now examined more closely by employing Figures 1 and 2. It is assumed first that the need for establishing a
10 connection between the subscriber terminal equipment and the base station appears at the subscriber terminal equipment 37. When the subscriber terminal equipment 37 initiates connection establishment, it sends on the access channel (RACH) a transmission request or more generally a connection establishment request relating to several base station transceiver
15 units to one base station 33 from which the request is forwarded to the base station controller 31. In the solution of the invention, several base stations, for example base stations 33 to 35, respond on their paging channel to the connection establishment request or the response connection operates via several base stations or beams or sectors of the base stations. The base
20 station transceiver unit 40 to 47 attends to the transmission and reception operation and the connection in the direction of the beam or sector of the base stations 33 to 36. Thus in the solution of the invention the connection between the subscriber terminal equipment 37 and the base stations 33 to 36 is established in the random access way to more than one base station
25 transceiver unit 40 to 42 included in one or more base stations 33 to 34. After the connection has been established, if a traffic channel connection is needed, the subscriber terminal equipment 37 has a ready traffic channel connection to several base station transceiver units 40 to 42.

A typical connection establishment, which also uses traffic
30 channels, takes place in the CDMA system as in the following Table 1:

Table 1. Connection establishment

Subscriber terminal equipment	Channel used	Base station
[Receives a call	Paging channel	Sends a call]
Sends a request	Access channel	Receives a request
Receives a Ch Ass M	Paging channel	Sends a Ch Ass M
Communication on the traffic channel		

In Table 1 the events are in chronological order so that the time axis may be imagined to travel from top to bottom. On the uppermost line the base station calls the subscriber terminal equipment on a paging channel. The subscriber terminal equipment responds to this request on its access channel and requests a connection to several base station transceiver units, which is shown on the second line in Table 1. The base station responds to the request by sending a Channel Assignment Message (Ch Ass M), after which the base station and the subscriber terminal equipment communicate on the normal traffic channel. The first line in Table 1 is in brackets because when the base station contacts the base station, Table 1 should be read without its first line. That is, the subscriber terminal equipment then sends a connection request to the base station, which is shown on the second line of the table. After this the base station responds in the same way as in the previous case and it results in a traffic channel connection.

Before the subscriber terminal equipment 37 sends a connection establishment request, the subscriber terminal equipment 37 selects preferably from the base station transceivers 40 to 47 the ones where the quality of the connection is presumably the best and to which it would be preferably in connection. In this way the subscriber terminal equipment sends information about the base station transceiver units 40 to 45 it has selected on the access channel to the base station controller 30 via the base station transceiver unit providing the best connection, which may be the base station transceiver unit 41. In the preferred embodiment of the invention, the base station controller 31 allows all or at least some of the base station transceiver units 40 to 45 selected by the subscriber terminal equipment, and the allowed base station transceiver units, such as 40 to 42, respond to the subscriber terminal equipment on their paging channel and thus establish preferably a macrodiversity connection of soft random access type with the subscriber

terminal equipment 37. The reason why the base station controller 31 may restrict the number of the base station transceiver units may be the heavy loading of the system at that moment, which loading the base station controller 31 wishes to restrict when allocating new channels.

5 In an alternative procedure, the subscriber terminal equipment 37 also sends a transmission request to several base station transceivers 40 to 42. This may be based on the use of one random access channel or on that the base station transceiver 40 to 42 comprises a receiver for random access channels of several cells. This procedure may have several purposes. At its
10 simplest, connection establishment is initiated along with several base station transceivers 40 to 42 but the actual connection will be established with only one transceiver. The connection has been established with the best connection at that moment. In a more advanced alternative, the connection establishment message may also proceed via several base station
15 transceivers. In the third alternative the message proceeds along one route but the other base station transceivers are synchronized with the connection request of the subscriber terminal equipment without being able to interpret the message correctly. This will also accelerate the generation of the actual macrodiversity connection.

20 The subscriber terminal equipment 37, as the other subscriber terminal equipments of the system, evaluates the quality of the connection by utilizing the measuring result of the transmission power of the pilot signal of the base stations 33 to 36 and the power of the received pilot signal. Further, the measuring result of the downlink interference will have an effect on the
25 quality of the connection. On the basis of at least one of the above measuring results of the quality of the connection, the subscriber terminal equipment 37 selects from the base station transceiver units 40 to 47 the ones where the quality of the connection is the best.

The base stations 33 to 36 generally send a base station specific
30 pilot signal and data on the transmission power of the pilot signal and the size of the uplink interference I_{uplink} on their sync channel. The subscriber terminal equipments 37 and 38 measure the strength of the received pilot signal and the size of the downlink interference I_{downlink} . If the transmission power of the all the pilot signals is the same, in the preferred embodiment of the invention the
35 selection means 15 of the subscriber terminal equipment 37 selects the base station transceiver units where the received power of the pilot signal is the

strongest. If the pilot signals are sent on different power, the power of the transmitted and received pilot signal is compared to one another and it will result in a connection distance attenuation L which can be indicated as a formula in the following way:

5

$$L = \frac{P_{TX,pilot}}{P_{RX,pilot}}, \quad (1)$$

where $P_{TX,pilot}$ is the power of the transmitted pilot signal and $P_{RX,pilot}$ is the power of the received pilot signal. In the preferred embodiment of the invention, this value L is used for selecting base station transceiver units. Thus the connection evaluation means 14 forms a parameter L representing connection distance attenuation and on the basis of this, the selection means 15 select the candidates for the connection from the base station transceiver units.

15

By considering also the required signal interference ratio SIR_{req} in both uplink and downlink directions, the required transmission power may be calculated for both the subscriber terminal equipment P_{MS} and the base station transceiver unit P_{BTS} . The required signal interference ratio SIR_{req} for the subscriber terminal equipment is

20

$$SIR_{req} = \frac{P_{MS}}{L \cdot I_{uplink}}, \quad (2)$$

from which it is obtained as the transmission power P_{MS} of the subscriber terminal equipment

25

$$P_{MS} = SIR_{req} \cdot I_{uplink} \cdot L \quad (3)$$

The required signal interference ratio SIR_{req} for the base station transceiver unit is

30

$$SIR_{req} = \frac{P_{BTS}}{L \cdot I_{downlink}}, \quad (4)$$

from which it is obtained the required transmission power P_{BTS} of the base station transceiver unit in the same way as in the case of the subscriber terminal equipment

$$5 \quad P_{BTS} = SIR_{req} \cdot I_{downlink} \cdot L \quad (5)$$

The solution of the invention uses parameters L , P_{MS} and P_{BTS} in a random access type algorithm. By means of a random access type algorithm, the selection means 15 of the subscriber terminal equipment selects the base station transceivers for which the connection distance attenuation L is smaller than some predetermined value and the transmission power of both the base station transceiver unit and the subscriber terminal equipment is preferably smaller. The power of the received signals is preferably measured before spread-coded signals are assembled, that is, from a broadband signal. The reception power of the pilot signal is measured by assembling a pseudo-noise signal of the pilot signal by means of a correlator.

In the following it is assumed that the need for establishing a connection between the subscriber terminal equipment and the base station arises at the base station, at the base station 35, for example. In this case the base station 35 sends on its paging channel a connection establishment request to the subscriber terminal equipment, which may be 38 in this case. The subscriber terminal equipment 38 responds to this request on its access channel and informs the base station controller 31 in its response signal of the base station transceiver units with which it is ready to establish a connection. From this point onwards the connection is established according to the invention similarly as when the subscriber terminal equipment 37 initiates connection establishment.

When operating in system based on FDMA (Frequency Division Multiple Access) or TDMA (Time Division Multiple Access), the solution of the invention is possible when using the same access channel to a random access type connection for several base station transceiver units. For example, a pilot signal is not sent in the GSM system, wherefore macrodiversity has to be generated without any previously evaluated quality information of the connection, or some other signal has to be used instead of the pilot signal for evaluating the quality of the connection. Instead of a pilot

signal, it is possible to use a BCCH signal which the base station transceiver unit sends on a BCCH channel (Broadcast Control Channel).

5 In a system using PRMA technique, data transmission takes place in packet mode. The connection establishment method is similar to the CDMA system described above. By using the solution of the invention also in packet-mode data transmission, several base station transceiver units can be used and macrodiversity will be attained, whereby changes in the quality of the connection are less significant than when in connection to only one base station or base station transceiver unit.

10 Although the invention has been explained above with reference to the examples of the appended drawings, it is evident that the invention is not restricted thereto, but it can be modified in various ways within the scope of the inventive idea disclosed in the accompanying claims.

CLAIMS

1. A connection establishment method comprising a random access type connection establishment using a random access channel, which is used in a radio system comprising several subscriber terminal equipments (37 to 38) and base stations (33 to 36) where one or more transceiver units (40 to 47) operate, and in which system connection establishment between the subscriber terminal equipment (37 to 38) and the base station (33 to 36) is possible when the subscriber terminal equipment (37 to 38) is situated in the coverage area of one or more transceiver units (40 to 47) of the base station, where the subscriber terminal equipment (37 to 38) evaluates the quality of the connections to be established, **characterized** in that the subscriber terminal equipment (37 to 38) forms a random access type connection to more than one base station transceiver unit (40 to 47) included in one or more base stations (33 to 38).
2. The method according to claim 1, **characterized** in that on the basis of the evaluated quality of the connection, the subscriber terminal equipment (37 to 38) selects before the actual connection establishment the base station transceiver units (40 to 47) to which the quality of the connection is the best and at least some of which units are used in the random access way when establishing a connection.
3. The method according to claim 1, **characterized** in that in its connection establishment request the subscriber terminal equipment (37 to 38) sends to a base station controller (31 to 32) via the base station transceiver unit (40 to 47), which provides the best connection, information about the base station transceiver units (40 to 47) selected by it, at least some of which units are used when establishing a connection.
4. The method according to claim 1, **characterized** in that the base station controller (31 to 32) allows at least some of the base station transceiver units (40 to 47) selected by the subscriber terminal equipment (37 to 38) to establish a connection with the subscriber terminal equipment (37 to 38).
5. The method according to claim 1, **characterized** in that the subscriber terminal equipment (37 to 38) evaluates the quality of the connection by using the measuring result of the transmission power in the pilot signal of the base station (33 to 36) and the power of the received pilot signal and on the basis of the quality of the connection, selects the base station

transceiver units (40 to 47) where the power of the received pilot signal is the greatest in comparison with the transmitted power.

6. The method according to claim 1, **characterized** in that the subscriber terminal equipment (37 to 38) evaluates the quality of the connection by utilizing the measuring result of downlink interference, and on the basis of the quality of the connection, selects the base station transceiver units (40 to 47) to which the connection operates on lower transmission power.

7. A subscriber terminal equipment (37 to 38) which is arranged to establish a random access type connection by using a random access channel in a radio system comprising several subscriber terminal equipments (37 to 38) and base stations (33 to 38) which comprise one or more transceiver units (40 to 47), and in which system the connection between the subscriber terminal equipment (37 to 38) and the base station (33 to 38) is possible when the subscriber terminal equipment (37 to 38) is situated in the coverage area of one or more base station transceiver units (40 to 47), where the subscriber terminal equipment (37 to 38) comprises an evaluation means (14) for monitoring the quality of the connections to be established, **characterized** in that the subscriber terminal equipment (37 to 38) comprises a control means (19) for controlling a random access type connection establishment to more than one base station transceiver (40 to 47) included in one or more base stations (33 to 36).

8. A subscriber terminal equipment (37 to 38) according to claim 7, **characterized** in that the subscriber terminal equipment (37 to 38) comprises a selection means (15) for selecting on the basis of the evaluated quality of the connection the base station transceiver units (40 to 47) to which the quality of the connection is the best, and

the control means (19) is arranged to control the subscriber terminal equipment (37 to 38) in such a manner that the subscriber terminal equipment (37 to 38) sends information about the base station transceiver units (40 to 47) selected by the selection means (15) to a base station controller (31 to 32) on the random access channel via the base station transceiver unit (40 to 47) providing the best connection.

9. A subscriber terminal equipment (37 to 38) according to claim 7, **characterized** in that an evaluation means (14) is arranged to monitor the quality of the connection by using the measuring result of the transmission power in the pilot signal of the base station (33 to 36) and the received power

and on the basis of the quality of the connection, the selection means (15) is arranged to select the base station transceiver units (40 to 47) where the power of the received pilot signal is the greatest in comparison with the transmitted power.

5 10. A subscriber terminal equipment (37 to 38) according to claim 7, **characterized** in that the evaluation means (14) is arranged to monitor the quality of the connection by utilizing the measuring result of downlink interference, and on the basis of the quality of the connection, the selection means (15) is arranged to select the base station transceiver units (40 to 47)
10 to which the connection operates on lower transmission power.

 11. A radio system comprising several subscriber terminal equipments (37 to 38) and base stations (33 to 36) which comprise one or more base station transceiver units (40 to 47) and where the subscriber terminal equipment (37 to 38) is arranged to send a random access type
15 connection establishment request via a random access channel and in which system the connection between the subscriber terminal equipment (37 to 38) and the base station (33 to 36) is possible when the subscriber terminal equipment (37 to 38) is situated in the coverage area of one or more transceiver units (40 to 47) of the base station (33 to 36), where the subscriber
20 terminal equipment (37 to 38) comprises an evaluation means (14) for monitoring the quality of the connections to be established, **characterized** in that the radio system comprises a subscriber terminal equipment (37 to 38) which is arranged to control a random access type connection establishment between the base station (33 to 36) and the subscriber terminal
25 equipment (37 to 38) so that it is possible for the subscriber terminal equipment (37 to 38) to establish a connection to more than one base station transceiver unit (40 to 47) included in one or more base stations (33 to 36).

 12. A radio system according to claim 11, **characterized** in that the subscriber terminal equipment (37 to 38) of the radio system is
30 arranged

to select on the basis of the quality of the connection the base station transceiver units (40 to 47) to which the quality of the connection is the best,

to send information about the base station transceiver units (40 to
35 47) it has selected to a base station controller (31 to 32) on the random access

channel via the base station transceiver unit (40 to 47) providing the best connection, and

that the base station controller (31 to 32) of the radio system is arranged to allow at least some of the base station transceiver units (40 to 47) selected by the subscriber terminal equipment (37 to 38) to be used for the connections required by the subscriber terminal equipment (37 to 38).

13. A radio system according to claim 11, **characterized** in that the subscriber terminal equipment (37 to 38) is arranged to evaluate the quality of the connection by using the measuring result of the transmission power in the pilot signal of the base station transceiver unit (40 to 47) and the received power and on the basis of the quality of the connection, the subscriber terminal equipment (37 to 38) is arranged to select the base station transceiver units (40 to 47) where the power of the received pilot signal is the greatest in comparison with the transmitted power.

14. A radio system according to claim 11, **characterized** in that the subscriber terminal equipment (37 to 38) of the radio system is arranged to evaluate the quality of the connection by utilizing the measuring result of downlink interference, and that on the basis of the quality of the connection, the subscriber terminal equipment (37 to 38) is arranged to select the base station transceiver units (40 to 47) to which the connection operates on lower transmission power.

15. A radio system according to claim 11, **characterized** in that one or more base station transceivers (40 to 47) are arranged to receive the connection establishment request of the subscriber terminal equipment (37 to 38).

16. A radio system according to claim 11, **characterized** in that one or more subscriber terminal equipments (40 to 47) are arranged to be synchronized with the connection establishment request of the subscriber terminal equipment (37 to 38).

1/1

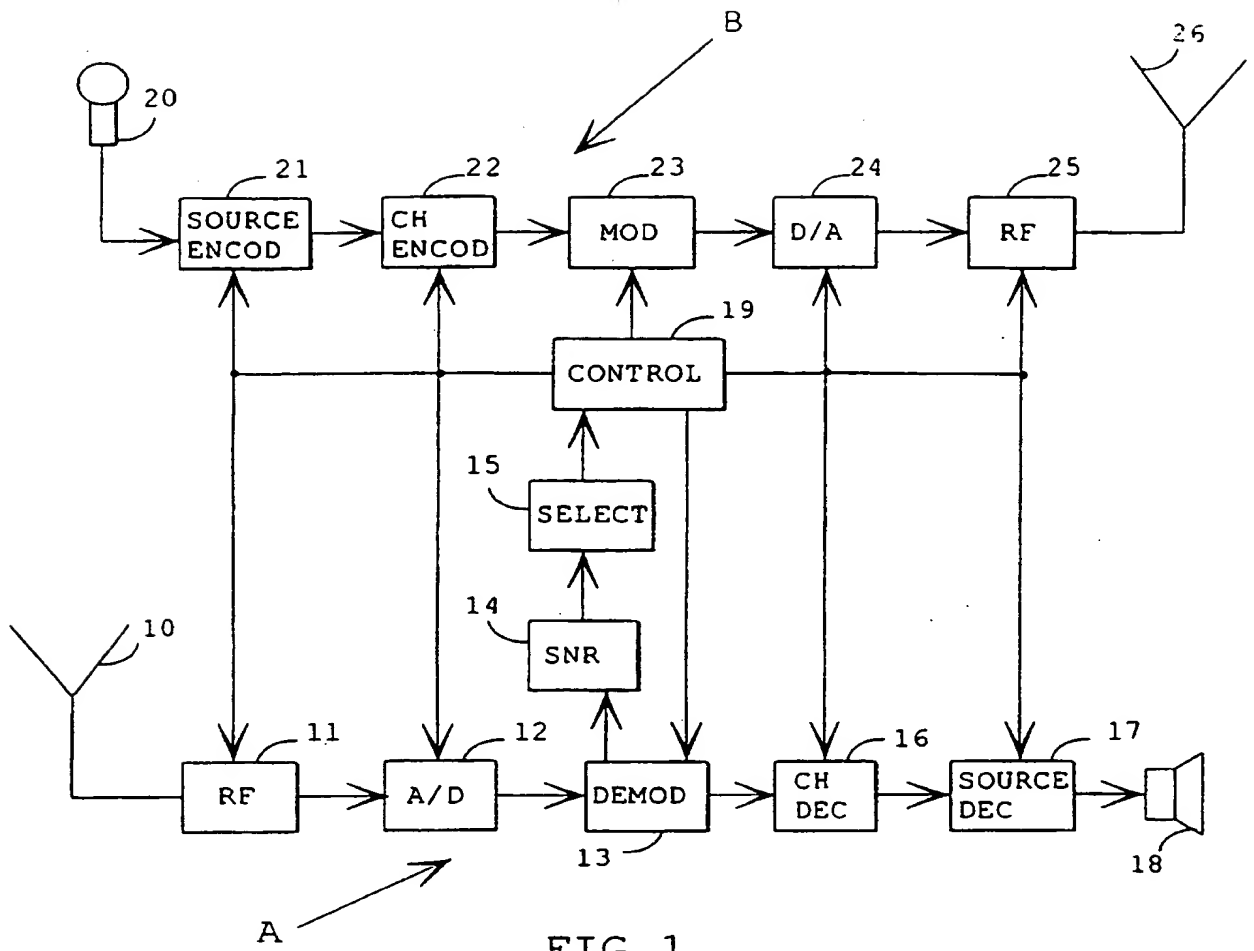


FIG 1

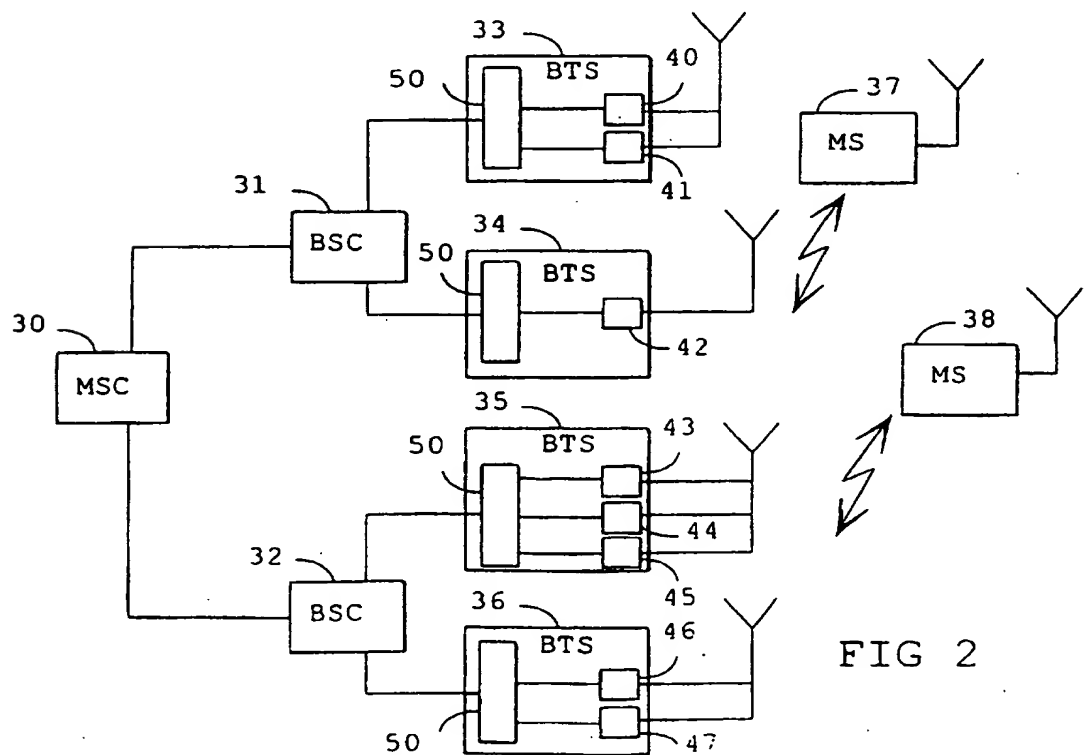


FIG 2



1/1

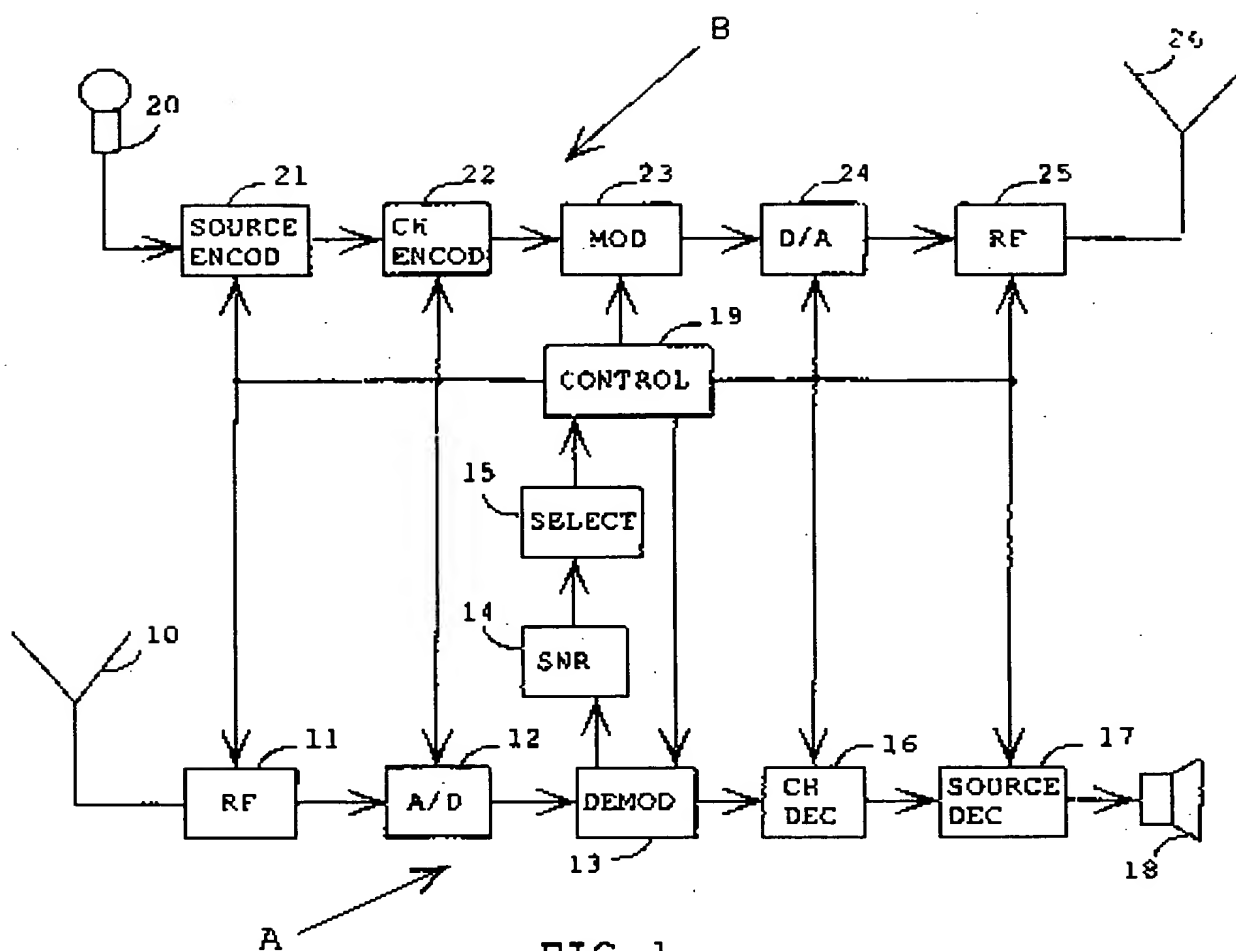


FIG 1

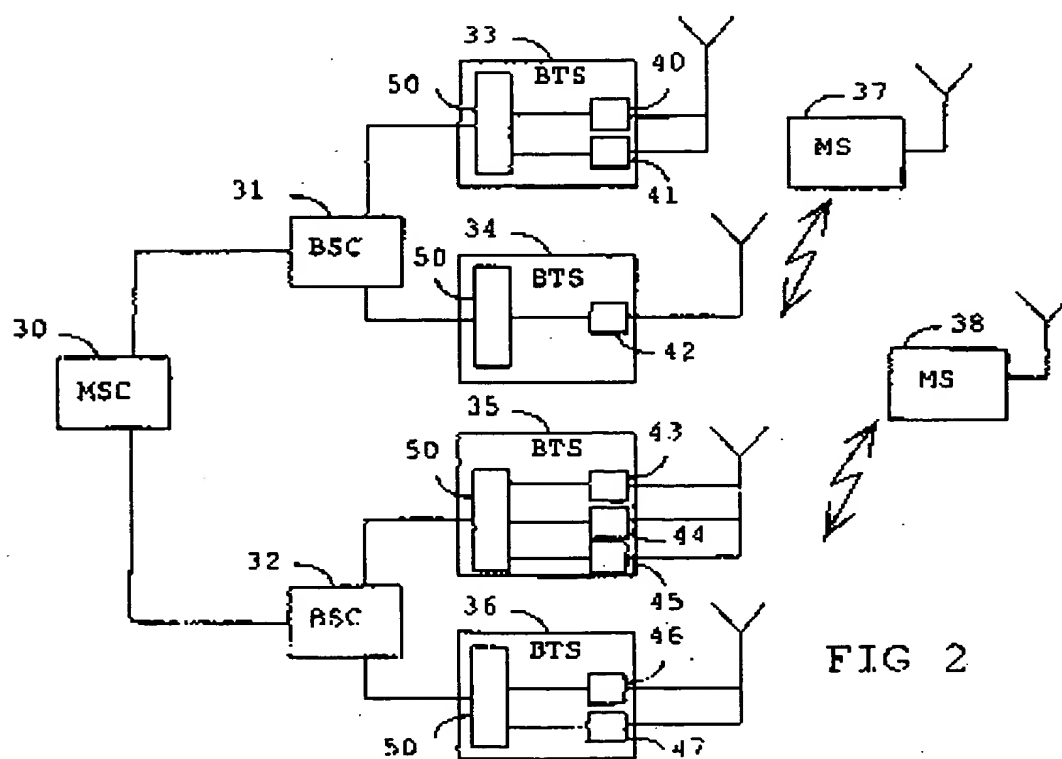


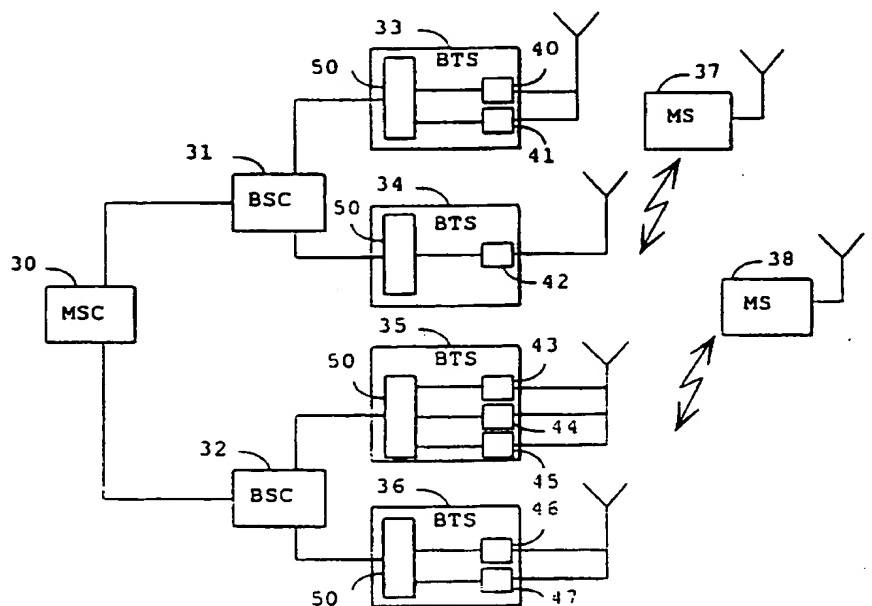
FIG 2



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : H04Q 7/20, 7/32, 7/38 // H04Q 7/00	A3	(11) International Publication Number: WO 97/29596 (43) International Publication Date: 14 August 1997 (14.08.97)
(21) International Application Number: PCT/FI97/00064 (22) International Filing Date: 4 February 1997 (04.02.97) (30) Priority Data: 960541 6 February 1996 (06.02.96) FI (71) Applicant (for all designated States except US): NOKIA TELECOMMUNICATIONS OY [FI/FI]; Upseerinkatu 1, FIN-02600 Espoo (FI). (72) Inventors; and (75) Inventors/Applicants (for US only): HÄKKINEN, Hannu [FI/FI]; Vuokselantie 10 B, FIN-02140 Espoo (FI). GRANLUND, Seppo [FI/FI]; Meritullinkatu 9 B, FIN-00170 Helsinki (FI). HÄMÄLÄINEN, Seppo [FI/FI]; Lintuvaarantie 21 A 5, FIN-02600 Espoo (FI). (74) Agent: TEKNOPOLIS KOLSTER OY; c/o Kolster Oy AB, Iso Roobertinkatu 23, P.O. Box 148, FIN-00121 Helsinki (FI).		(81) Designated States: AU, BR, CA, CN, JP, KR, NO, NZ, PL, SG, US, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i> (88) Date of publication of the international search report: 18 September 1997 (18.09.97)

(54) Title: A CONNECTION ESTABLISHMENT METHOD, A SUBSCRIBER TERMINAL UNIT AND A RADIO SYSTEM

**(57) Abstract**

The present invention relates to a method for establishing a random access type connection and a subscriber terminal equipment (37 to 38) and a radio system operating in accordance with the method. The subscriber terminal equipment (37 to 38) establishes a connection to several base stations (33 to 36) with the method of the invention. The base stations (33 to 36) are selected before establishing the connection by deducing the quality of the connection by means of pilot signals and both uplink and downlink interferences. The subscriber terminal equipment (37 to 38) has a connection to several base stations (33 to 36) already at the initial stage of the connection.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AM	Armenia	GB	United Kingdom	MW	Malawi
AT	Austria	GE	Georgia	MX	Mexico
AU	Australia	GN	Guinea	NE	Niger
BB	Barbados	GR	Greece	NL	Netherlands
BE	Belgium	HU	Hungary	NO	Norway
BF	Burkina Faso	IE	Ireland	NZ	New Zealand
BG	Bulgaria	IT	Italy	PL	Poland
BJ	Benin	JP	Japan	PT	Portugal
BR	Brazil	KE	Kenya	RO	Romania
BY	Belarus	KG	Kyrgyzstan	RU	Russian Federation
CA	Canada	KP	Democratic People's Republic of Korea	SD	Sudan
CF	Central African Republic	KR	Republic of Korea	SE	Sweden
CG	Congo	KZ	Kazakhstan	SG	Singapore
CH	Switzerland	LI	Liechtenstein	SI	Slovenia
CI	Côte d'Ivoire	LK	Sri Lanka	SK	Slovakia
CM	Cameroon	LR	Liberia	SN	Senegal
CN	China	LT	Lithuania	SZ	Swaziland
CS	Czechoslovakia	LU	Luxembourg	TD	Chad
CZ	Czech Republic	LV	Latvia	TG	Togo
DE	Germany	MC	Monaco	TJ	Tajikistan
DK	Denmark	MD	Republic of Moldova	TT	Trinidad and Tobago
EE	Estonia	MG	Madagascar	UA	Ukraine
ES	Spain	ML	Mali	UG	Uganda
FI	Finland	MN	Mongolia	US	United States of America
FR	France	MR	Mauritania	UZ	Uzbekistan
GA	Gabon			VN	Viet Nam

INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 97/00064

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H04Q 7/20, H04Q 7/32, H04Q 7/38 // H04Q 7/00
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0288904 A2 (MOTOROLA INC.), 2 November 1988 (02.11.88), column 1, line 50 - line 53; column 2, line 11 - line 21; column 2, line 47 - line 49, claim 4, abstract, column 3, line 9 - line 15; column 6, line 4 - column 7, line 17; column 8, line 52 - column 9, line 12 --	1-16
X	EP 0565507 A2 (ERICSSON - GE MOBILE COMMUNICATIONS INC.), 13 October 1993 (13.10.93), abstract --	1-16
X	WO 9107037 A1 (QUALCOMM, INC.), 16 May 1991 (16.05.91), page 14, line 21 - page 15, line 10 --	1-16

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

- "A" document concerning the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

31 July 1997

Date of mailing of the international search report

02 -08- 1997

Name and mailing address of the ISA/
Swedish Patent Office
Box 5055, S-102 42 STOCKHOLM
Facsimile No. +46 8 666 02 86

Authorized officer

Mikael Sollerhed
Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 97/00064

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4435840 A (JUNICHIROH KOJIMA ET AL), 6 March 1984 (06.03.84), column 3, line 34 - line 46 -- -----	1-16

INTERNATIONAL SEARCH REPORT
Information on patent family members

01/07/97

International application No.
PCT/FI 97/00064

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0288904 A2	02/11/88	AT 148293 T	15/02/97
		CA 1286040 A	09/07/91
		CN 1014761 B	13/11/91
		CN 1030336 A	11/01/89
		DE 3855764 D	00/00/00
		ES 2097734 T	16/04/97
		FI 94693 B,C	30/06/95
		KR 9600527 B	08/01/96
		NO 175695 B,C	08/08/94
		US 4797947 A	10/01/89
		WO 8808650 A	03/11/88
EP 0565507 A2	13/10/93	AU 667923 B	18/04/96
		AU 4280693 A	18/11/93
		BR 9305478 A	11/10/94
		CA 2111000 A	28/10/93
		FI 935525 D	00/00/00
		JP 8502151 T	05/03/96
		NZ 252801 A	25/09/96
		US 5430760 A	04/07/95
		WO 9321692 A	28/10/93
WO 9107037 A1	16/05/91	AU 646001 B	03/02/94
		AU 6728390 A	31/05/91
		CA 2072989 A	08/05/91
		CN 1025402 B	06/07/94
		CN 1053870 A	14/08/91
		CN 1090107 A	27/07/94
		EP 0500689 A	02/09/92
		IL 96218 A	27/02/94
		JP 4502841 T	21/05/92
		US 5056109 A	08/10/91
		US 5257283 A	26/10/93
		US 5265119 A	23/11/93
		US 5267262 A	30/11/93
		US 5485486 A	16/01/96
US 4435840 A	06/03/84	AU 546036 B	08/08/85
		AU 8509582 A	06/01/83
		CA 1176311 A	16/10/84
		JP 1516439 C	07/09/89
		JP 58161542 A	26/09/83
		JP 63065247 B	15/12/88
		AU 1366283 A	27/10/83
		GB 2125124 A,B	29/02/84
		JP 1516441 C	07/09/89
		JP 58173925 A	12/10/83
		JP 63065248 B	15/12/88
		JP 1483437 C	27/02/89
		JP 57210739 A	24/12/82
		JP 63029862 B	15/06/88

THIS PAGE LEFT BLANK